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PENSOFT

Expansion of *Aedes* (*Stegomyia*) *albopictus* (Skuse, 1894) in northern Brazil: new records and distribution in urban areas of Macapa city

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Abstract

New investigations using ovitraps showed its presence the *Aedes albopictus* (Skuse, 1894) in four neighborhoods in the metropolitan region of Macapa, capital of Amapa, Brazil. An *Aedes aegypti* (Linnaeus, 1762) Infestation Index Rapid Survey (LIR*Aa*) held in January 2020 indicated the presence of *Ae. albopictus* in 10 different neighborhoods, demonstrating increase dispersion in the municipality. Monitoring the distribution of *Ae. albopictus* is necessary due to related arboviruses transmission, such as Dengue, Zika and Chikungunya. Therefore, this research is relevant to public health in Brazil.

Keywords

Arboviruses, Asian Tiger Mosquito, vector control

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Introduction

After 30 years of the first report in Brazil (Forattini 1986) and more than 15 years of its record in the northern region (Segura et al. 2003), *Aedes* (*Stegomyia*) *albopictus* (Skuse, 1894) (Diptera, Culicidae) was found in Amapa state on an island in the municipality of Santana (Saraiva et al. 2019). It is spreading in Macapa, the state capital of

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Amapa. Known as the Asian Tiger Mosquito, this species is considered a secondary vector for important arboviruses, such as Dengue, Zika, and Chikungunya (Paupy et al. 2009; Smartt et al. 2017). It has a wide distribution within Brazil (Carvalho et al. 2014; Ferreira-de-Lima et al. 2020).

Amapa state is part of the Brazilian Legal Amazon and borders with Para, which is the state in the northern region where *Ae. albopictus* was first reported (Segura et al. 2003). Macapa, the capital of Amapa, is a city covered by the Amazon River and located about 4 km from Santana municipality, where the vector was first reported in the state (Saraiva et al. 2019). The continuous flow of people by road, river, and air transportation between the municipalities of Santana and Macapa, and the states of Para and Amapa, can lead to the spread of mosquitoes.

With a population of 500,000, Macapa is the most populous city in the state (IBGE 2020). The city is crossed by the Equator line with a hot and humid climate characterized by wet and drought season (December to July and August to November, respectively), and average daily temperature of 24.6–32.1 °C.

The climate is hot and humid, with the average daily temperature of 24.6–32.1 °C, characterized by wet and drought season (December to July and August to November, respectively). The annual accumulated rainfall is 2511.03 mm (NHMET/IEPA 2020). In Macapa, most people lack basic sanitation (Brazil 2016), which in combination with the climatic conditions are important factors for proliferation of the genus *Aedes* Meigen, 1818.

Methods

This study was conducted in Macapa urban area and divided in four different stages:

- **First stage September 2018.** Aiming to detect the presence of *Ae. Albopictus*, 170 ovitraps were installed in four Macapa neighborhoods: Fazendinha, Pedrinhas, Infraero I, and Açai. Species identification was performed with ovitraps groups from each neighborhood according to the entomological keys of Rueda (2004) and Segura and Castro (2007). The collected specimens were examined in the laboratory using a Global Optics Series NO106 zoom stereoscope. All images were obtained by using an attached camera (Full HD 1080p) with AMCap v. 9.23 software. Photograph were edited in Adobe Photoshop v. 22.2.0.
- **Second stage.** The neighborhood with the greatest number of *Ae. albopictus* was selected and new ovitraps were installed to verify the mosquito geographic distribution. Species identification was performed for each ovitrap according to the entomological keys described in the previous stage.
- **Third stage (November 2019).** Health education with Endemic Disease Control Agents' in Macapa municipality.
- **Fourth stage (January 2020).** Data analysis in the *Aedes aegypti* Infestation Index Rapid Survey (LIR*Aa*) in Macapa.

Ethics approval for this study was obtained from the Research Ethics Committee of the Institute of Scientific and Technological Research of Amapa (approval consent no. 1.944.859).

Results

Aedes (*Stegomyia*) *albopictus* (Skuse, 1894)

New records. BRAZIL • Amapa: Macapa, Fazendinha; 00°02′50.0″S, 051°06′51.6″W; 26 Sep. 2018; Josiane Nogueira Müller leg.; 9 ♂ and 9 ♀, adults; IEPA DIP 11235–11252.

Identification. For adult mosquitoes we used the thorax and head characteristics (Fig. 1). Scutum with a narrow,

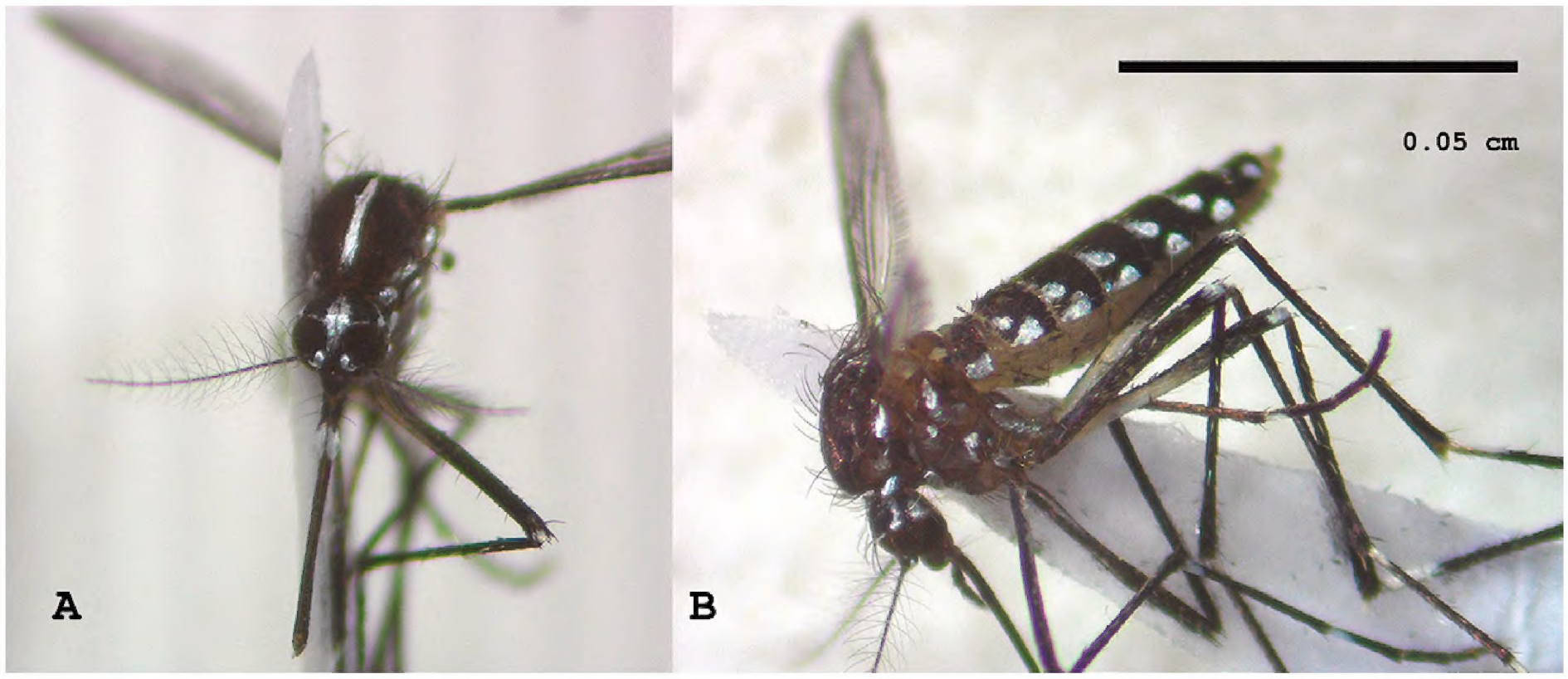

Figure 1. *Aedes* (*Stegomyia*) *albopictus* (Skuse, 1894) (Diptera: Culicidae). **A.** Dorsal view. **B.** Lateral view.

median-longitudinal, white stripe and clypeus without white scale patches, respectively (Rueda 2004; Segura and Castro 2007).

Comments. First stage. *Aedes albopictus* was found during sampling ovitraps for *Aedes aegypti* (L). larvae. The traps were installed in July 2018 in four different neighborhoods in Macapa: Fazendinha, Pedrinhas, Infraero I, and Açai. Fazendinha and Pedrinhas are located in the south zone, and Infraero I and Açai in the north. Identified *Ae. albopictus* larvae were held in the Laboratório de Fisiologia e Controle dos Artrópodes Vetores – Laficave insectary, where they emerged from the pupa. The screening of adults found 81 female (♀) and 79 male (♂) individuals in Fazendinha neighborhood, 2♀ and 1♂ in Pedrinhas, 10♀ and 5♂ in Infraero I, and 12♀ and 6♂ in Açai neighborhood.

Second stage. Based on the results of the first stage, 39 ovitraps were installed in Fazendinha neighborhood for 7 days in November 2018. Egg deposition was recorded as negative or positive, with 23 ovitraps negative and 16 positive (Fig. 2). Among the positive ovitraps, *Ae. aegypti* was identified in nine ovitraps, *Ae. albopictus* in only one, and both species were found in six ovitraps (Table 1). Larvae were held in the Laboratório de Entomologia Médica (IEPA). Of the total number of adults, 106 were identified as *Ae. albopictus* (vouchers specimens were deposited in the entomological collection of IEPA # 11235–11252). These represent the first records of *Ae. albopictus* in the municipality of Macapa.

Third and fourth stage. Following the previous findings, the vectors control staff in Macapa were provided a training session in November 2019, which emphasized characteristics of *Aedes* species and the importance of *Aedes* species both locally and nationally. Thus, in the

Table 1. Positive ovitrap to eggs from *Aedes* mosquito install in Fazendinha neighborhood in Macapa, Amapa state, Brazil.

Ovitrap	*Aedes albopictus*			*Aedes aegypti*		
	♂	♀	Total	♂	♀	Total
P1	0	0	0	8	11	19
P2	0	0	0	11	13	24
P3	10	7	17	7	15	22
P4	8	5	13	2	3	5
P5	9	8	17	15	21	36
P6	0	0	0	8	19	27
P7	0	0	0	0	2	2
P8	11	12	23	0	0	0
P9	0	0	0	13	23	36
P10	0	0	0	12	26	38
P11	0	0	0	24	28	52
P12	0	7	7	8	8	16
P13	0	0	0	23	33	56
P14	7	4	11	10	23	33
P15	10	8	18	25	17	42
P16	0	0	0	25	54	79
Total	55	51	106	191	296	487

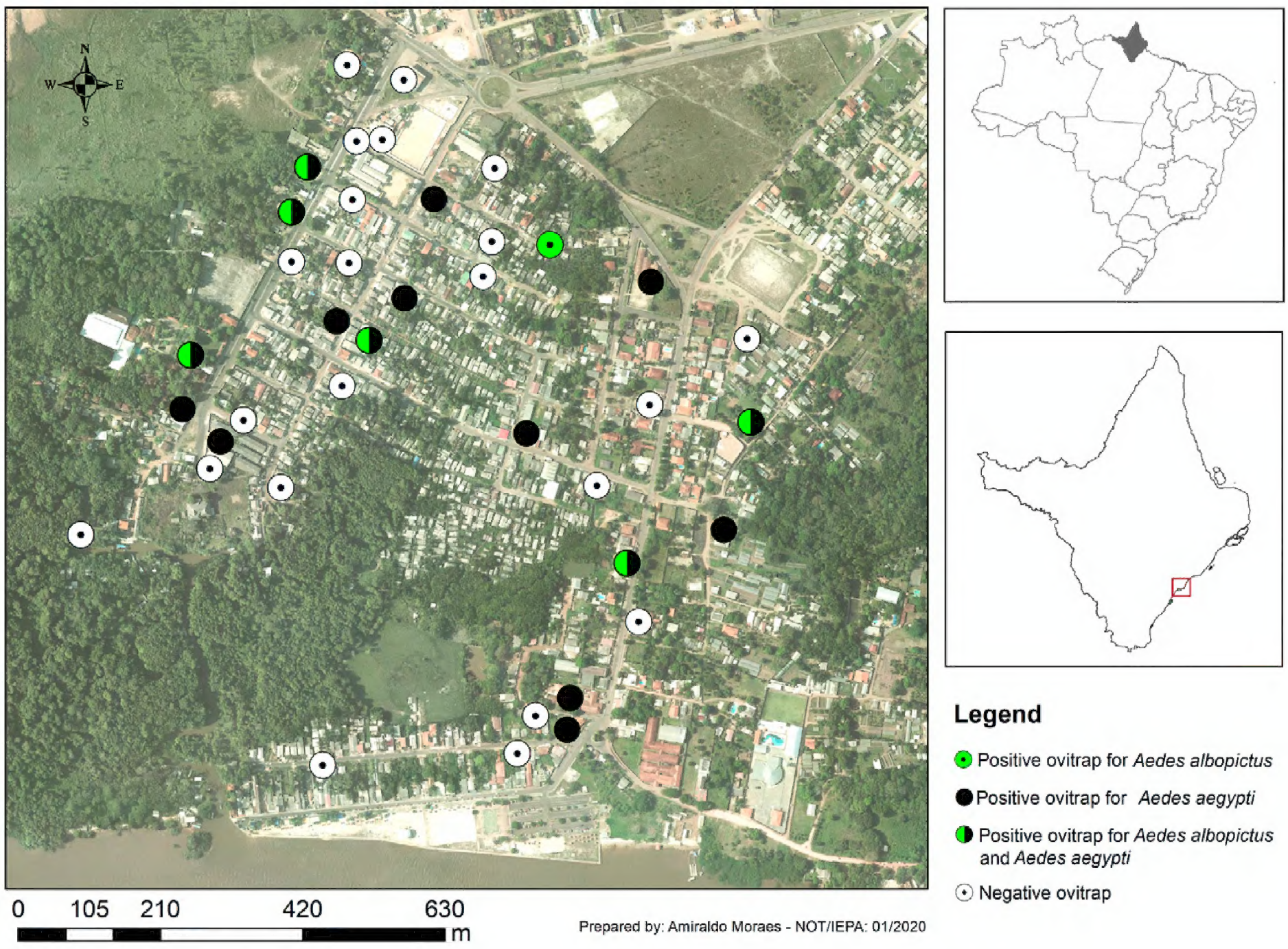

Figure 2. Ovitrap distribution in Fazendinha neighborhood, Macapa, Amapa state, Brazil. Source: NOT/IEPA.

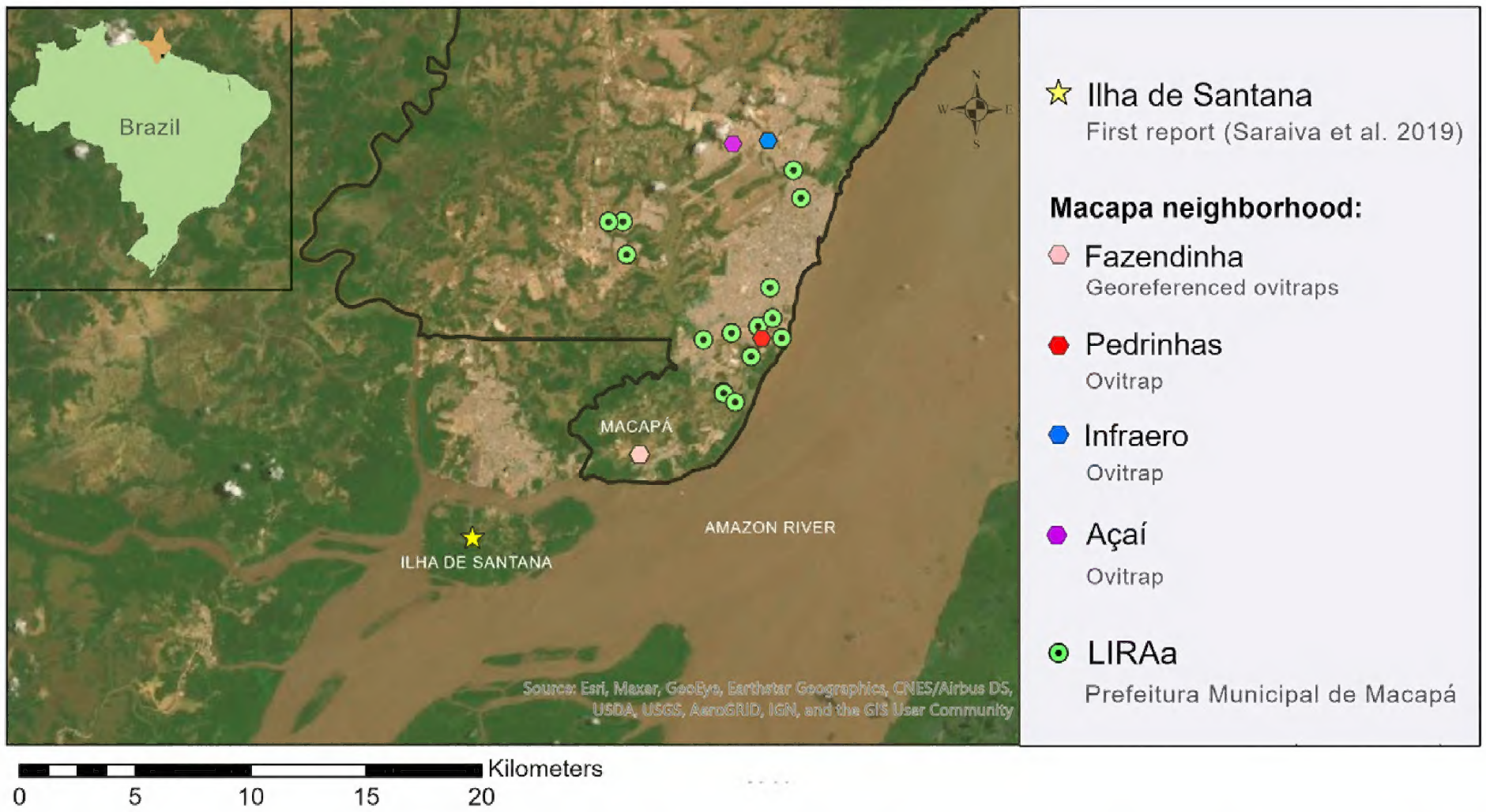

Figure 3. Neighborhoods in which *Aedes albopictus* were found in the city of Macapa, Amapa state, Brazil. Learn ArcGIS (https://bit.ly/ArcGISProFree).

first Infestation Index Rapid Survey (LIR*Aa*) in 2020, breeding of *Ae. albopictus* were found in 10 neighborhoods of Macapa: Cabralzinho, Renascer, Marabaixo, Beirol, Pacoval, Zerão, Pedrinhas, Jardim Marco Zero, Universidade and Rodovia JK (Fig. 3).

Discussion

With the exception of Acre state, the presence of *Aedes albopictus* has been reported in all states of Brazil (Saraiva et al. 2019; Ferreira-de-Lima et al. 2020). Its spread in urban areas and its important capacity as a vector of arboviruses have been monitored in several studies (Arduino et al. 2020; Honorio et al. 2019; Melo Ximenes et al. 2020).

The state of Amapa borders French Guiana in the north and Suriname in the northwest. These countries have no record of the vector's presence (Talaga et al. 2015; WRBU 2020). However, one of the main routes for commodities in and out of Para and other states is by river, therefore we believe that commerce and river transportation may be a possible route of entry for *Ae. albopictus*. In addition, Amapa has socio-cultural characteristics and favorable environmental conditions for proliferation, maintenance, and spread of the vector. We are not entirely clear whether the vector's spreading in the state is related with the transport of people and/or goods, since the first record occurred during a study with other vector species (Saraiva et al. 2019). However, this hypothesis can be verified using molecular data to determine the genetic lineage of mosquitoes.

Based on the first report by Saraiva et al. (2019) of *Ae. Albopictus* in in Amapa, our study was undertaken and confirmed the presence of this species in the urban area of Macapa. Thus, entomological surveillance is important in the discovery of new outbreaks of *Aedes* spp. and in monitoring and controlling their spread, which will help minimize the impact of virus diseases transmitted by these insects.

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Authors' Contributions

JBL, AKG, JSJ, and MCL designed the study. JBL and AKG supervised the study. JNM, WMS, and EPF made the field collections and studied the specimens. JNM and LSD raised the mosquitoes in the insectary. JNM, APC, and WMS prepared the manuscript. JSJ and MCL performed the data analysis of LIR*Aa*. JBL and AKG reviewed whole text.

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